U. S. DEPARTMENT OF AGRICULTURE.

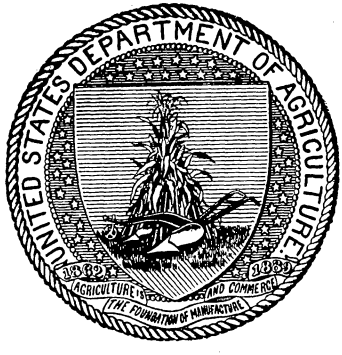
FARMERS' BULLETIN No. 163.

METHODS OF CONTROLLING THE BOLL WEEVIL.

[Advice based on the work of 1902.]

BY

W. D. HUNTER,
SPECIAL FIELD AGENT.



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., January 6, 1903.

SIR: I transmit with this a brief manuscript by Mr. W. D. Hunter, a special agent of this Division in charge of experimental work with the Mexican cotton boll weevil (*Anthonomus grandis*). I have examined this manuscript and warmly approve of its recommendations. I urge its immediate publication as a Farmers' Bulletin.

Respectfully,

L. O. HOWARD, *Entomologist.*

Hon. JAMES WILSON,
Secretary of Agriculture.

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INTRODUCTORY.

The Division of Entomology has worked with the boll weevil since the first appearance of the pest in Texas in 1894. Up to the present time practically continuous observations have been made upon its natural history, habits, and the means by which it reaches new regions; and the results of these observations, with suggestions regarding the manner of combating the pest, drawn from them and from the experience of many planters, have already been published. It was not, however, until the last season that the funds at the disposal of the Division permitted experimental field work on a considerable scale. By special appropriation, which became available on the 4th of June, 1902, it became possible for the Division to conduct field work on a large scale and according to a system that gives tangible and presentable results. The arrangement consists of a contract whereby certain planters agree to plant, cultivate, and care for the crop exactly in accordance with the directions of the agent of the Division. It consequently gives the Division practically complete charge of large tracts of cotton in typical situations without involving the labor and expense of renting the land and working the crop. In this way 200 acres at Calvert and 150 acres at Victoria, Tex,, were used for experimental purposes. A complete field laboratory was established at the latter place for rearing work, breeding parasites, and testing poisons, as well as investigating every feature of the life history of the weevil that may afford any advantage in fighting the pest.

Though somewhat handicapped by the late date at which the appropriation became available, the work of the past season has demonstrated many important points. The principal ones are presented in the following pages, together with such previously acquired information as constitutes, it is believed, the basis of a practical and effective system of producing the staple anywhere that the boll weevil occurs.

TERRITORY AFFECTED.

Though still confined to Texas, the territory occupied by the cotton-boll weevil (*Anthonomus grandis* Boh.) at present includes about 28 per cent of the cotton acreage in the United States. This acreage in

1900 produced 34 per cent of the total crop of this country, or one-fourth of the crop of the world for that year. As will be seen from the accompanying map (fig. 1), this region is bounded on the north

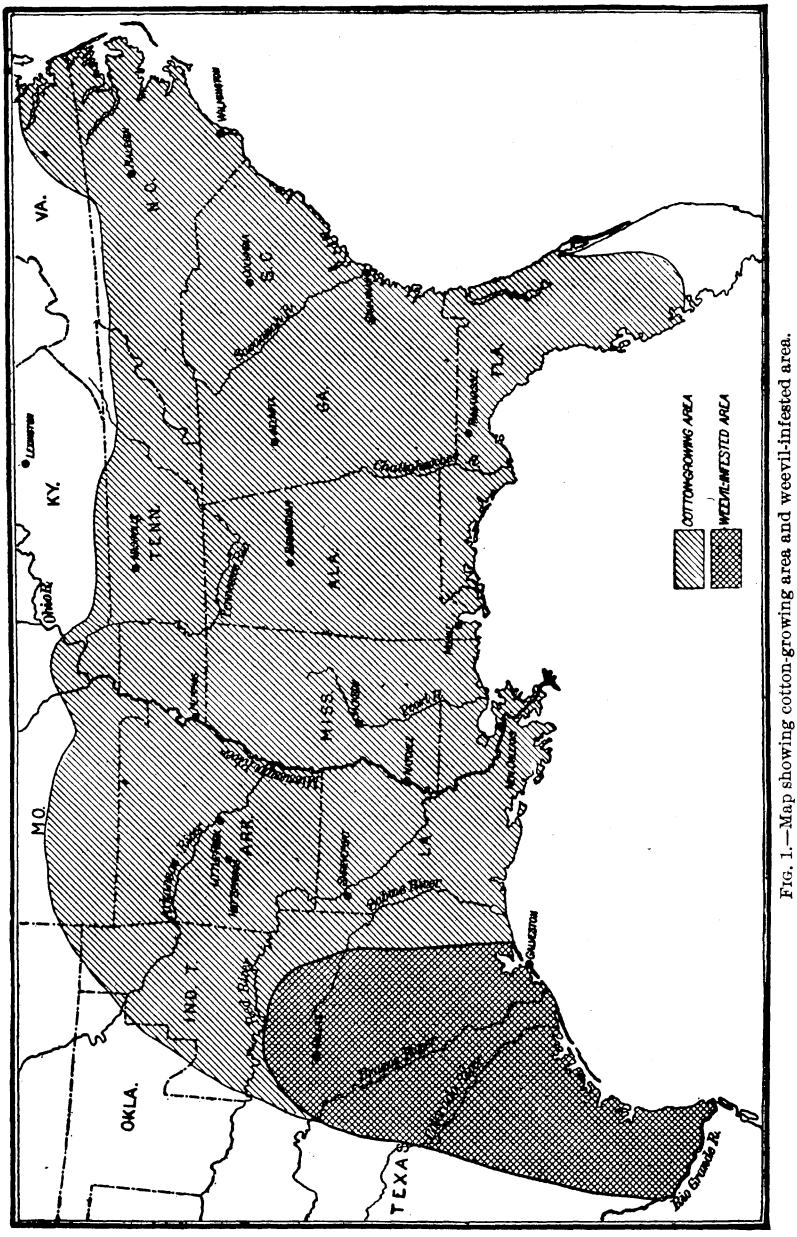

FIG. 1.—Map showing cotton-growing area and weevil-infested area.

by the Red River and on the east by the pine forests of the divide between the Trinity and Sabine rivers. It includes all of the 22 counties, which, in 1899, according to the Twelfth Census, produced

40,000 bales or more each. In the newly invaded region, however, between the latitude of Dallas and the Red River, the insect, though scatteringly present, has not multiplied to such an extent as to cause much damage.

AMOUNT OF DAMAGE.

Various estimates of the loss occasioned to the cotton planters during the past year have been made. They range from 235,000 to 500,000 bales, representing from 8 to 25 millions of dollars. In the nature of the case, such estimates must be made upon data difficult to obtain, and in the collection of which many errors must inevitably occur. As is well known, there is a general tendency to exaggerate agricultural losses, as well as to attribute to a single factor damage that is the result of a combination of many influences. Before the advent of the boll weevil into Texas, unfavorable weather at planting time, summer drought, and heavy fall rains, as well as the attack of many other noxious insects, caused very light crops to be produced. Now, however, the tendency is to attribute all of the shortage to the weevil. Nevertheless, not only on account of the very serious work of the insect, but also on account of the rather unfortunate previous condition of the cotton-producing industry, the boll weevil is among the most formidable menaces to an agricultural industry that ever arose in this country or elsewhere. It seems well within the bounds of conservatism to state that during 1902 the insect caused Texas a loss of at least 10 millions of dollars.

In spite of the generally serious outlook, it must be stated that fears of the damage the weevil may do are often, especially in a newly invaded district, very much exaggerated. It is by no means necessary to abandon cotton. The Division of Entomology has demonstrated the past season that the crop can be grown profitably in spite of the boll weevil. Moreover, the experience of many counties in south Texas shows how a locality can, in a short time, adapt itself to the new system of cotton raising made necessary by the weevil. The experience of Victoria County illustrates this point well. The following table shows the production of cotton since the advent of the boll weevil. No accurate statistics of acreage are available, but it is the uniform testimony of the most reliable planters that the acreage has not been increased very materially.

Cotton production in Victoria County, Tex., and in the United States, in equivalents of 500-pound bales.

Year.	Crop of Victoria County.	Crop of United States.	Year.	Crop of Victoria County.	Crop of United States.
	Bales.	*Millions of bales.*		*Bales.*	*Millions of bales.*
1894	6,895	10.5	1898	7,006	12.1
1895	4,404	7.5	1899	5,547	9.9
1896	9,796	9.2	1900	11,956	11.1
1897	7,746	11.9	1901	9,060	9.5

Besides showing in general a successful continuation of cotton culture in Victoria County since the weevil reached it, the above table indicates that the crop of the United States at large has varied year by year in much the same way as has the crop of Victoria County, showing that climatic conditions affecting the entire cotton belt have been a much more important factor than the weevil in reducing the crop in a series of years.

FUTURE PROSPECTS.

The most serious aspect of the situation is in the fact that the pest is constantly spreading and will undoubtedly eventually be distributed all over the cotton belt. There are no influences that can check it short of the limit of its food plant in this country. In Mexico, where the insect has existed as an important enemy of cotton for a much longer period than in the United States, the investigations of the Division of Entomology, as well as of the Mexican Government, indicate that the only factor in limiting its distribution is that of altitude. In the famous "Laguna" district in that country, including portions of the States of Coahuila, Chihuahua, and Durango, the weevil has never gained a foothold, notwithstanding the fact that large quantities of seed cotton are annually shipped there for ginning and milling from the lower region, where it is very numerous. That this region, under these circumstances, has never become infested seems only to be explained by its altitude, which is disastrous to an insect which probably originated in a region of very low elevation. The average elevation of the "Laguna" district is about 3,500 feet above sea level. Unfortunately, in this country there is no land at all adapted to cotton culture in the belt as now constituted that approaches such an elevation.

Basing the estimate on a careful study of the annual increase in territory since the insect reached Texas, as well as upon considerable attention that has been paid to the means whereby it reaches new territory, it seems safe to predict that in from fifteen to eighteen years the pest will be a serious drawback to cotton culture everywhere throughout the South, as it is in Texas now.

METHODS OF COMBATING.

It is wholly beyond possibility that the weevil is ever to be exterminated. Its history in Mexico and since reaching Texas, as well as the history of many related injurious insects, offers no hope that it will ever be much less destructive than now. Nevertheless, it has been demonstrated that cotton can be grown profitably by means of a few expedients in planting and managing the crop where the insect is present. These expedients involve no appreciable extra expense in producing the staple, and accordingly are coming to be generally

adopted in preference to direct means, such as poisons and machines, which, aside from their doubtful utility under many conditions, involve expenses for labor or material that soon hopelessly reduce the margin of profit.

During the past season the Division of Entomology has been engaged in field experiments to demonstrate that cotton can be produced successfully in spite of the boll weevil. Some of this work was conducted on the plantation of Col. E. S. Peters, in the Brazos Valley, near Calvert, Texas. This valley is, on account of its low and moist situation, the presence of timber, and the almost exclusive production of cotton, the most seriously affected portion of the weevil territory. In fact, the most favorable conditions possible for the multiplication of the insect are there present, and Colonel Peters's plantation is a typical one.

The accompanying diagram (fig. 2) shows the location of some of the experimental fields. The soil is the typical alluvial deposit of the valley and practically identical throughout the 128 acres included in this experiment. The seed was the ordinary seed of the region, grown on the same plantation the year before, of an unknown variety, as is usually the case in that region. The stand was equally good everywhere. No means of fighting the weevil whatever, aside from those mentioned, were practiced. In none of the fields did any other insects, aside from the weevil, cause any considerable injury. The bollworm was present, but did very little damage; the sharpshooter was scarcely noticed; and the leaf worm did not appear in sufficient numbers to warrant poisoning.

To summarize the results of these experiments:

1. Early planted cotton with thorough cultivation produced two-thirds of a bale per acre.

2. Early planted cotton with careless cultivation produced one-ninth of a bale per acre.

3. Early planted cotton with fair cultivation produced one-half bale per acre.

4. Late planted cotton with wide rows yielded about one-fourth of a bale per acre.

5. Late planted cotton with narrow rows, sprayed thoroughly, yielded about one-fourth of a bale per acre.

The evident conclusions are:

First. A profitable crop in the most unfavorable situation can be produced by early planting and thorough cultivation, as in Field I (fig. 2). This field produced one bale to 1.5 acres; the average production in the United States is one bale to 2.3 acres. The experiment, moreover, was performed during probably the most generally disastrous season for cotton culture in Texas for twenty-five years.

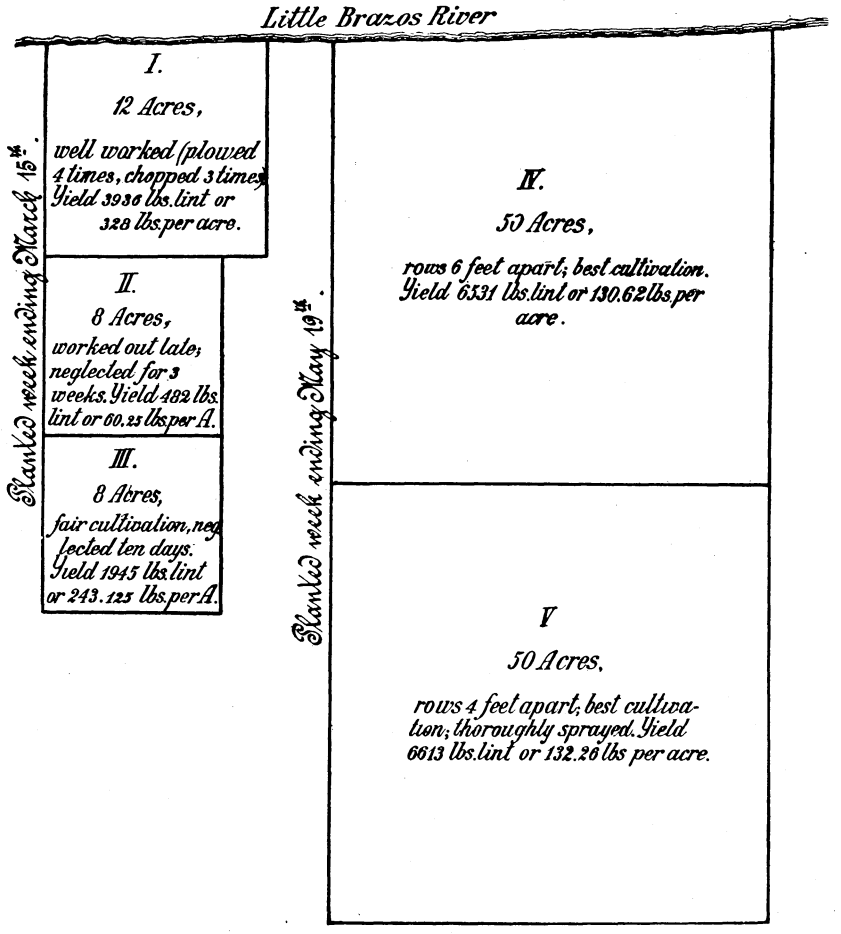

FIG. 2.—Experimental cotton field.

NOTE.—Although the field of 50 acres with the rows 6 feet apart yielded less lint than the field of 50 acres with the rows 4 feet apart, the margin of profit was greater on the former on account of the saving in chopping. A tabular statement follows:

Yield on 50 acres with rows 4 feet apart	pounds	6,613
Yield on 50 acres with rows 6 feet apart	do	6,531
Yield in favor of narrow rows	do	82
Value of excess at 8 cents per pound		$6.56
Cost of chopping 50 acres with rows 4 feet apart, at $1.25 per acre		$62.50
Cost of chopping 50 acres with rows 6 feet apart, at 85 cents per acre		$42.50
Saving in favor of wide rows		$20.00
Saving in cost of chopping wide rows		$20.00
Value of gain in lint in narrow rows		$6.56
Actual gain in favor of wide rows		$13.44

Second. Early planting not followed by thorough cultivation is of no avail, as illustrated in case of Field II (fig. 2). From this comes the important suggestion that planters should exercise the greatest care to avoid allowing a tenant more land than he can cultivate thoroughly. "Overcropping" would destroy all the benefit of early planting.

Third. The bad effect of late planting can not be remedied by wide spacing, by subsequent thorough cultivation, nor by spraying. But, nevertheless, late planting with thorough cultivation is better than early planting with careless cultivation, as is shown by comparing the results in Fields IV and V with those in Field II (fig. 2).

Fourth. In case the main crop can be planted early, the trouble and expense of planting trap rows for the weevil is entirely unnecessary.

Without going fully into details, it can be said that the work of the Division of Entomology has demonstrated several other very important points. Among these is the fact that the use of Northern seed and the seed of especially early-maturing varieties will increase the advantage of earliness in planting. It is very likely that in Field I, by using certain seed, the yield could have been brought up to at least three-fourths of a bale to the acre.

At Victoria early fall destruction of the plants the preceding year was found to bring about a very noticeable decrease in the number of weevils. For instance, as late as October 10, in a field upon which plants of the previous year had been destroyed by September 20, about 33 per cent of the squares were uninjured, while on fields in similar situations, planted about the same time, but upon which the plants had not been destroyed in the fall, it was impossible to find a case where more than 8 per cent of the squares were uninjured at that time.

It was also shown at Victoria that the weevils caused less damage in cotton planted only moderately early (week ending March 10) on land upon which the plants of the preceding season had been destroyed by burning early in the fall than in fields planted late (week ending April 30) on land that had never been in cotton and which, moreover, were measurably isolated from other cotton fields.

There are two methods of destroying the plants, namely, grazing, and burning after uprooting by plowing. There are three important general difficulties in the way of grazing: (1) It is not at present feasible in the portions of Texas where the bulk of the cotton crop is produced on account of the small number of cattle present; (2) in fields where Johnson grass is starting, cattle, by spreading it, would probably do much more harm than good; and (3) in many fields the nature of the soil, if tramped upon by cattle, would make it impossible to carry on thorough cultivation the following season. But burning the stalks by October 1, thereby preventing the maturing of many fall

broods as well as destroying many weevils that take refuge in the windrows as soon as the plants are uprooted, is feasible, effective, and economical, and consequently should be generally practiced.

The tendency of some planters to allow the plants to stand in the field, in the hope of securing a top crop, is one of the most serious obstacles in the fight against the weevil. The statistics as well as the testimony of the most experienced cotton planters in Texas show that there has not been any appreciable top crop produced in Texas in more than three years in the past quarter of a century. It is, therefore, safe to state that the gain to the planter the following season in a lessened number of weevils will always more than compensate him for the loss of any top crop he is likely to obtain.

The Department's experiments show that the matter of spacing the rows is rather uncertain. The distance depends upon the nature of the soil and the variety of the cotton grown. Moreover, much depends upon the season. During a very wet year plants will grow to such an extent as to make the greatest feasible distance unimportant from the weevil standpoint. In this matter the planter must always act in accordance with the experience he has had upon his land. It will be well, however, to bear in mind that the distance between plants in the row is fully as important as the distance between the rows. The nearer the soil area to each plant approaches a square, the greater the yield will be. At the same time, too great spacing, besides decreasing the yield, actually delays the fruitage, and is, therefore, especially to be avoided. As nearly as a rule can be formulated, it may be stated that on the river bottom soil, which produces the bulk of the Texas crop, a distance of 5½ feet between the rows in a series of years would not be too great, while there are very few upland fields where 4 feet would be too great. A point in this connection that is frequently overlooked is in the great saving of labor when the rows are wide. For instance, it costs about one-third less to crop a field with rows 6 feet apart than one with rows 4 feet apart.

INEFFECTIVE METHODS OF COMBATING THE WEEVIL.

In order to save the cotton growers useless expenditure of time and means, attention is called to certain ineffective methods of combating the boll weevil.

NOSTRUMS.

Several specifics in the form of poisons for the destruction of the boll weevil have been widely advertised. At the laboratory in Victoria these have all been tested and found absolutely useless. The weevil being an insect that in all stages except one feeds well protected in the square or boll, and takes nourishment in the remaining stage

almost exclusively by inserting its beak well within the tissue of the fruit, will never be reached by such means. It can not be stated too emphatically that money paid for these ingeniously advertised substances is wasted.

In this connection it may be stated that there is no known variety of cotton that is immune against the attack of the boll weevil, notwithstanding the advertising claims of certain seed dealers. The only advantage one variety can possibly have over another is in point of early maturity.

MACHINES.

Many attempts have been made to perfect a machine that will assist in destroying the weevil. The Division of Entomology has carefully investigated the merits of representatives of all classes of these, beginning in 1895 with a square collecting machine at Beeville that had attracted considerable local attention. Up to the present time, however, none of these devices has been found to be practicable or to offer any definite hope of being ultimately successful. The difficulty and expense of working a machine when most needed, as in very wet weather, will probably always prevent them from coming into use. If it were not possible to raise cotton profitably without the use of a machine, the situation would be materially changed. But since it is possible, as is shown in this bulletin, to produce the staple without the use of any other means than those that enter into cotton culture everywhere, there seems no hope for these machines. If perfected at all, they will undoubtedly meet the same fate as the many complicated devices for destroying or poisoning the cotton-leaf worm with which planters and entomologists were especially concerned about twenty years ago, the wrecks of which may now be found upon any of the older plantations in Texas.

COTTON-SEED MEAL.

Recently the report has been circulated that cotton-seed meal exerts a powerful attraction for the weevil, and that they may consequently be killed easily by mixing poisons with it. This report seems to gain credence in some quarters, and unfortunately may reach as wide circulation as did the fallacious theory propounded last July that mineral paint would kill the pest. The Division of Entomology has experimented exhaustively, not only in the laboratory but in the field, with cotton-seed meal and finds that it is totally useless. In the laboratory weevils were confined in cages with meal and squares and in other cages with meal and cotton leaves. In no case during continuous watching for several days was a weevil found leaving the squares or leaves to feed upon the meal. In the field, sacks of meal were placed in five different cotton fields where weevils were plentiful;

examinations were made daily for eleven days, but only a single weevil was found on the meal, and that one seemed to be merely seeking the protection of the sack. During the eleven days many weevils were caught and placed upon the sacks of meal, but in no case were they found there the next day. It is difficult to see how a more forcible demonstration of the futility of cotton-seed meal as an attractant for the weevils could be presented.

EGYPTIAN COTTON AND THE BOLL WEEVIL.

Peculiar circumstances surrounding one of the Department's experimental fields of Egyptian cotton at San Antonio gave rise during the past season to a belief that such cotton is exempt from injury by the boll weevil. Unfortunately this unqualified idea became widely circulated before the extent of resistance could be satisfactorily determined by careful experiments. The resulting interest is still manifest in frequent letters received from planters regarding the obtaining of "immune Egyptian seed."

As a matter of fact, numerous observations made during 1901 and 1902 on several varieties of Egyptian cotton growing at different places, show that at least certain varieties of this cotton are as susceptible to damage by boll weevil as ordinary upland sorts. In fact it would seem that they are much more likely to be injured than ordinary varieties of American cotton. The tendency of the varieties of Egyptian cotton observed is to grow a very large stalk. Absence of irrigation does not appreciably modify this tendency. Egyptian cotton is therefore invariably late in maturing, setting no bottom crop. Late cotton, wherever grown, is certain to be injured by the weevil. There is apparently nothing in the plants of at least certain varieties of Egyptian cotton which renders them distasteful to the insect, which in Mexico has been found working in tree cotton and in Texas in sea-island cotton, both as far removed botanically from American upland as is Egyptian. In the field at San Antonio by the middle of September the pests had increased to such an extent that every square was punctured, and the consequent absence of the preferred places for oviposition had driven them to many bolls that had previously given promise of developing. A few volunteer American upland plants growing among the Egyptian ones, though only 3½ feet in height, produced more of the staple per plant than did the surrounding Egyptian plants 5½ feet high.

While the observations of the writer indicate that none of the Egyptian varieties are immune to the weevil, it is the opinion of the plant breeders of the Bureau of Plant Industry that it may be possible that certain strains will be found to be in some degree resistant. However, they claim that further experiments are necessary to definitely determine whether certain varieties possess the quality of resistance to some extent.

SPECIFIC RECOMMENDATIONS.

The work of the Division of Entomology for several years has led to the recommendations which follow. It has been demonstrated in the experimental fields of the Department and by the experience of many cotton planters that by using these simple means a profitable crop can be produced in any situation where the boll weevil occurs:

I. Plant early. Plant, if possible, the seed of the varieties known to mature early, or at least obtain seed from as far north as possible. It is much better to run the risk of replanting, which is not an expensive operation, than to have the crop delayed. The practice of some planters of making two plantings to avoid having all the work of chopping thrown into a short period is a very bad policy from the boll weevil standpoint. Taking a series of years into consideration, it will not be found too early to plant cotton in the latitude of Houston and southward by the 25th of February; in the Brazos Valley, as far north as Waco, by the first week in March; and at no place in northern Texas later than about the 20th of March.

II. Cultivate the fields thoroughly. The principal benefit in this comes from the influence that such a practice has upon the constant growth and consequent early maturity of the crop. Very few weevils are killed by cultivation. Much of the benefit of early planting is lost unless it is followed by thorough cultivation. In case of unavoidably delayed planting the best hope of the planter is to cultivate the field in the most thorough manner possible. Three choppings and five plowings constitute as thorough a system of cultivation as is necessary in most cases.

III. Destroy, by plowing up, windrowing, and burning, all the cotton stalks in the fields not later than the first week in October. In some cases turning cattle into the fields is advisable. Aside from amounting to practical destruction of the plants, grazing of the cotton fields furnishes considerable forage at a time when it is generally much in demand.

IV. Plant the rows as far apart as experience with the land indicates is feasible and thin out the plants in the rows thoroughly.

In addition to these specific recommendations it may be stated that anything that can be done in the way of protecting birds, like the quail, which are known to feed upon the weevil, will undoubtedly be of advantage.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to Senators, Representatives, and Delegates in Congress, or to the Secretary of Agriculture, Washington, D. C. The missing numbers have been discontinued, being superseded by later bulletins.

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